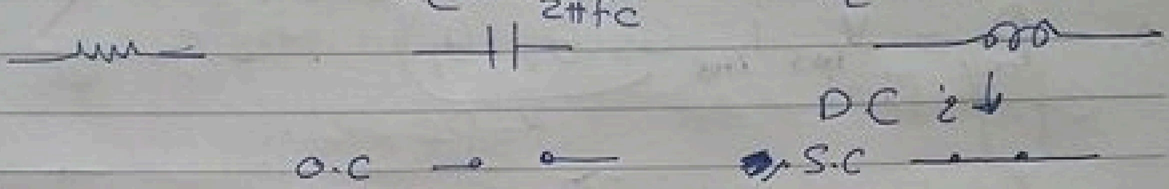
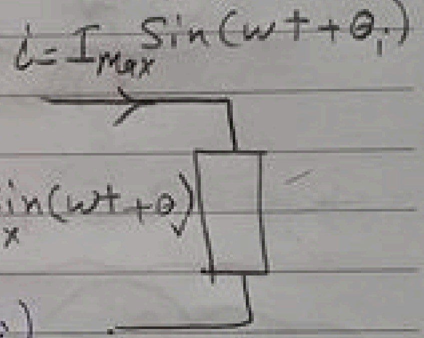
Series A.C Cicuit

$X_C = \frac{1}{2\pi f c}$ $X_L = 2\pi f L$



* Avrage Power and P.F



$P = i * v$

$\therefore P_{(t)} = V_m \sin(\omega t + \theta_v) * I_m \sin(\omega t + \theta_i)$

$\therefore P_{(t)} = I_m V_m \sin(\omega t + \theta_v) * (\sin \omega t + \theta_i)$

$\therefore P_{av} = \frac{1}{T}\int_0^T P(t)\,dt$

$\therefore \rightarrow P_{av} = \frac{1}{2\pi}\int_0^{2\pi} \frac{I_m V_m}{2}\left[\underbrace{\cos(\theta_v - \theta_i)}_{\text{ثابت لا يعتمد على الزمن التكامل له ويضربه * wt}} - \cos(2\omega t + \theta_v + \theta_i)\right] d(\omega t)$

Note ⇒ $\sin\theta_1 * \sin\theta_2 = \cos(\theta_1 - \theta_2] + \cos(\theta_1 + \theta_2$

⇐ التكامل مطلع = صفر للجزء $\cos(2\omega t + \theta_v + \theta_i)$ علشان
دالة ∿∿ المساحة فوق مع اللي تحت فيلغوا بعض أو بعضهم

$\therefore \Rightarrow P_{av} = \frac{V_m I_m}{4\pi}\left[\cos(\theta_v - \theta_i)\,\omega T\right]_0^{2\pi} = 0$

$\therefore P_{av} = \frac{V_m I_m}{{}_2 4\pi} \cos(\theta_v - \theta_i)\, 2\pi = \frac{V_m I_m}{\sqrt{2} * \sqrt{2}} \cos(\theta_v - \theta_i)$

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$\rightarrow \because \; V_{rms} = V_m/\sqrt{2} \qquad i_{rms} = i_m/\sqrt{2}$

$\therefore \; P_{av} = V_{rms}\, i_{rms} \underbrace{\cos(\theta_v - \theta_i)}_{= P.f}$

$\therefore \; \boxed{P_{av} = V I \; P.f}$

Real active.

ال av power قيمه وليس لها زوايا ... يعني هنعوض ب I ، V كقيمه من غير زوايا

$\Rightarrow$ لحساب ال power factor

لو الدايرة AC

$P_{av} = VI \cos(\theta_v - \theta_i)$

لو الدايره DC

$P = I^2 R = I.V$

القانون العام

$P_F = \dfrac{P_{av}}{V I}$

$\rightarrow$ في حاله المقاومه R $R \angle 0$

$\Rightarrow \; P_{av} = V I \cos\theta = V_{rms} I_{rms}$ "Watt"

الزاويه بين الجهد والتيار داخل المقاومه = صفر

$\rightarrow$ في حاله الملف L

$P_{av} = VI \cos\theta = \text{Zero}$

90° = الزاويه بين الجهد والتيار في الملف

$\rightarrow$ في حاله المكثف C

$P_{av} = VI \cos\theta = \text{Zero}$

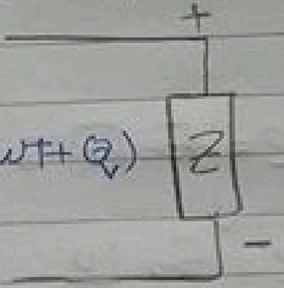
الزاوية داخل المكثف بين V ، I = -90

$\therefore$ المقاومة هي الوحيده اللي ليها P_{av}

Hi. Star

$Z \triangleq$ impedance

$i = I_M \sin(\omega t + \theta_i)$



$v = V_M \sin(\omega t + \theta_v)$

⇐ نكتل i و v بالشكل صورة ال Phasor.

$I = I_{Rms} \angle \theta_i$

$V = V_{Rms} \angle \theta_v$

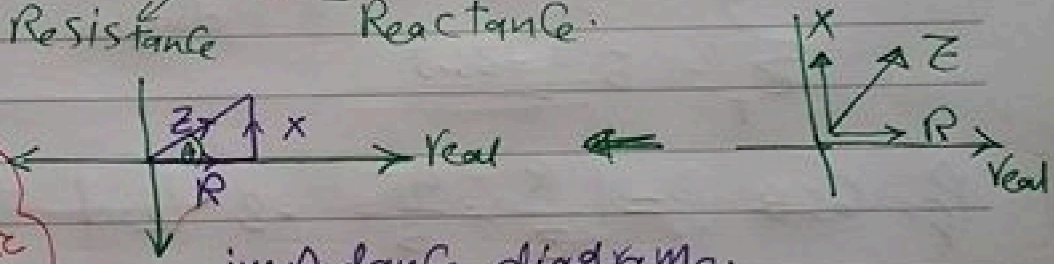
$$\Rightarrow Z = \frac{V}{I} = \frac{V_{Rms} \angle \theta_v}{I_{Rms} \angle \theta_i} = \frac{V}{I} \angle \theta_v - \theta_i$$

$$= |Z| \angle \theta_Z = |Z| \angle \theta$$ → Polar form

$\therefore Z = R + jX$ → Cartizial form.

Resistance   Reactance.

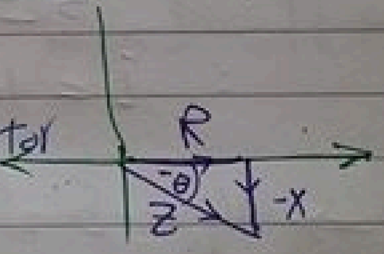
يسمى هذا ال impedance diagram



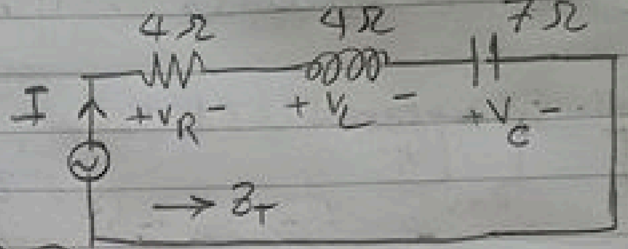
impedance diagrame.

→ laging power factor

→ leading power factor



ex:-



$e = 50\sqrt{2} \sin \omega t$

$\Downarrow$

$e = 50 \angle 0$

Solution

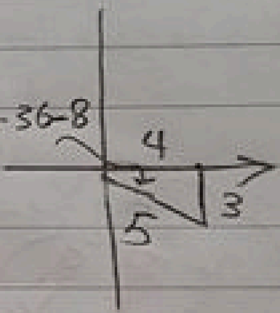
$\Rightarrow Z_T = Z_R + Z_L + Z_C = R\angle 0 + j(X_L - X_C)$

$\rightarrow R = R\angle 0 \quad = R + j\cdot 0$

$Z_L = 0 + j X_L \qquad Z_C = 0 - j X_C$

$\therefore Z_T = 4 - j3 \qquad \Rightarrow$ impedant diagram

$Z_T = 5 \angle -36.8$



$P_f = \cos\theta \quad = \frac{R}{Z} = \frac{4}{5} = .8$ lead

$\Rightarrow I = \frac{50\angle 0}{5\angle -36.87} = 10 \angle 36.87$

$\therefore i = 10\sqrt{2} \sin(\omega T + 36.87)$

$\Rightarrow V_R = E \frac{R\angle 0}{Z} = 50\angle 0 * \frac{4\angle 0}{5\angle -36.87} = 40 \angle 36.87$

$\Rightarrow V_L = I Z_L = 10\angle 36.87 * 4\angle 90 \quad$ or $V_L = E \frac{L\angle 90}{Z}$

$\therefore V_L = 40 \angle 126.87$

$\Rightarrow V_C = I Z_C = 10\angle 36.87 * 7\angle -90 = 40 \angle -53.13$

$P_s = \mathcal{E} I \cos\theta = 50 * 10 \cos(\theta)$

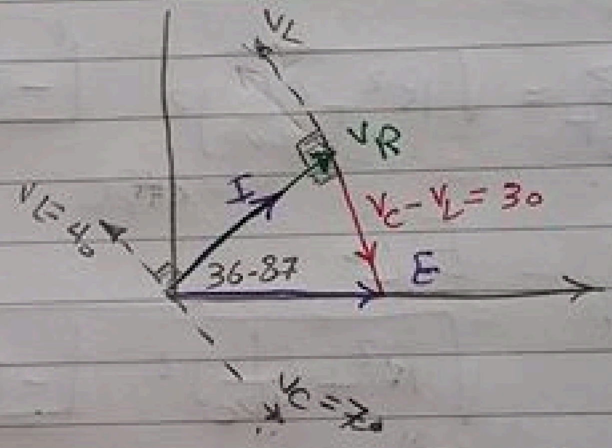
$P_s = 500 * \frac{4}{5} = 400$ watt

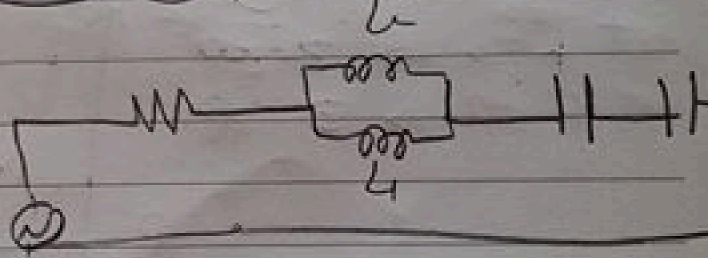
$P_R = I^2 R = (10)^2 * 4 = 400$

أو V_R / R

$P_L = Zero$ $\qquad P_C = Zero$

الملف والمكثف دائماً الـ power بتاعهم اللي بياخدوها = صفر





$\Rightarrow L = \frac{L_1 L_2}{L_1 + L_2} = \checkmark$

$X_L = \omega L = 2\pi f L$

$\Rightarrow C = \frac{C_1 C_2}{C_1 + C_2}$ $\quad \Rightarrow X_C = \frac{1}{\omega C}$

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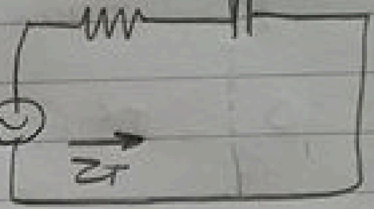
* Frequency Response

دائرة ترددها متغير

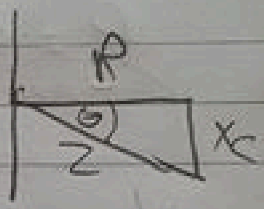


$\mathscr{f}\ E\angle 0$

$0 \to \infty$

$Z_T = R - j X_C$

$Z_T = \sqrt{R^2 + X_C^2} \ \angle -\tan^{-1}\left(\frac{X_C}{R}\right)$



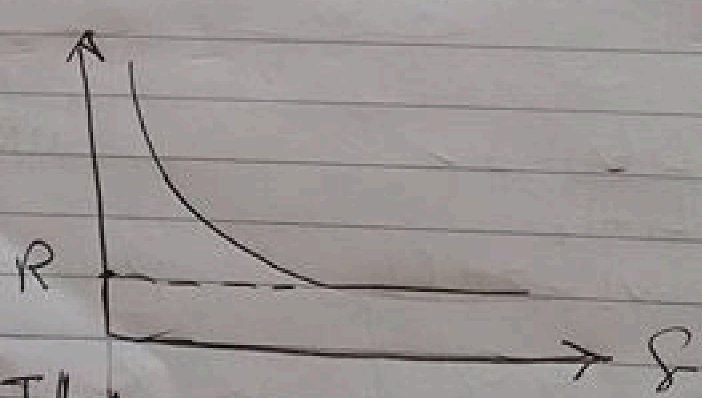
$\Rightarrow Z_T = \sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2} \ \angle \underbrace{-\tan^{-1}\left(\frac{1}{\omega C R}\right)}_{\theta_Z}$

$\omega = 2\pi f C$

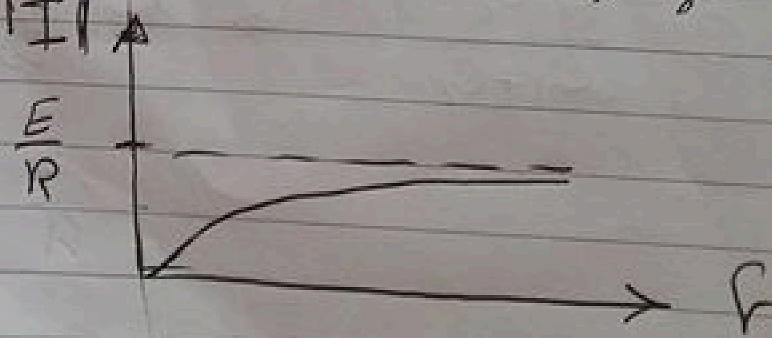
$$I = \frac{E\angle 0}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2} \ \angle -\tan^{-1}\left(\frac{1}{\omega C R}\right)}$$

at $f=0 \to Z = \infty$

at $f=\infty \to Z = R$



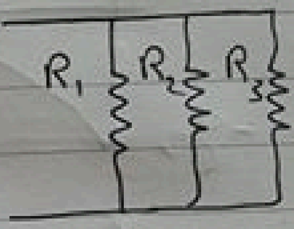
$\boxed{\begin{array}{ll} \text{at } f=0 & I=0 \\ \text{at } f=\infty & I=\frac{E}{R} \end{array}}$



* Paralel AC Curcuit :-

1. At DC

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \rightarrow$$

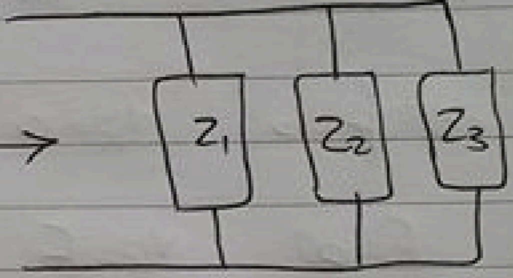


$\Downarrow$

$$G_T = G_1 + G_2 + G_3$$

2. At AC

$Z_i \rightarrow$



$$\frac{1}{Z_i} = \frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3}$$

$\Downarrow$

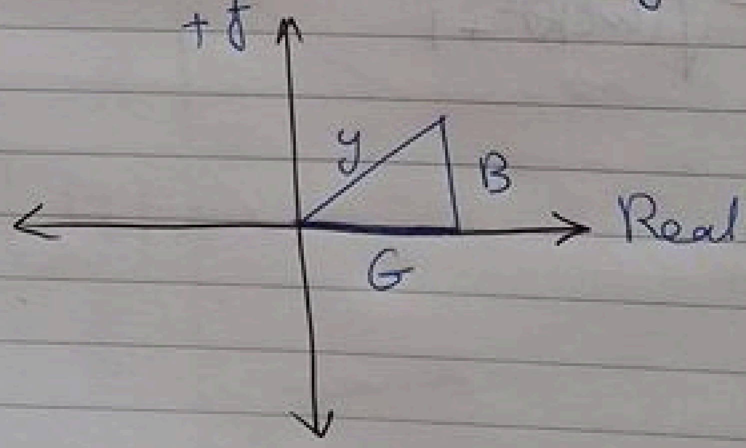
$$y_i = y_1 + y_2 + y_3 \quad : \Rightarrow y = \frac{1}{Z}$$

admitance ↑ susbtance

$$\rightarrow y = \frac{1}{Z} = G \pm j B \rightarrow = \frac{1}{X} \qquad = y \angle \theta_y$$

impedance ↓ conductance

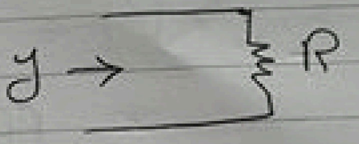
$$\theta_y = -\theta_Z$$



admitance diagram

y

المقاومة → $y_R = \frac{1}{Z} = \frac{1}{R}\angle 0$



$y_R = G\angle 0$

الملف → $y_L = \frac{1}{Z} = \frac{1}{X_L\angle 90} = \frac{1}{X_L}\angle -90$

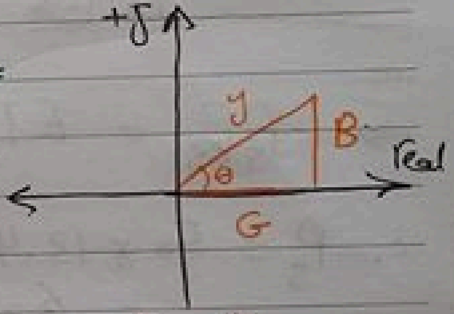
دايماً "90" % من الطلبة بتنسى الـ angle ...
عليهاااا

$y_L = B_L\angle 90 = -jB_L$

المكثف → $y_C = \frac{1}{Z_C} = \frac{1}{X_C\angle -90} = \frac{1}{X_C}\angle 90$

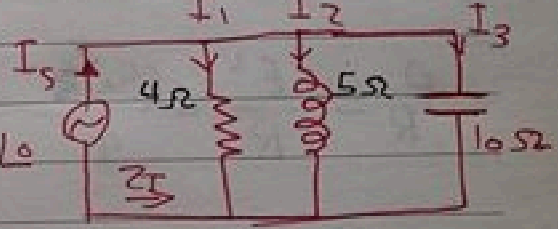
$\therefore y_C = B_C\angle 90 = jB_C\angle 90$

← لاحظت الـ admitance يكون مرسوم
في الربع الأول بيكون الـ element ده مكثف "C".



* المطلوب ← هات كل حاجة. ==

(Solution)

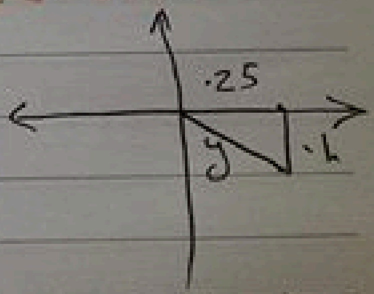


$R \Rightarrow y_T = y_1 + y_2 + y_3$

$y_T = \frac{1}{4} + \frac{1}{5\angle 90} + \frac{1}{10\angle -90} = .269\angle -21.8$

* الغلطات بتيجي من هنا "نسيان الزاوية" والمسألة بتبوظ.

$\therefore \Rightarrow y_T = .25 + j\,0.1$



$\therefore Z_T = \frac{1}{y_1} = 3.714\angle 21.8$

$\Rightarrow P.F = \cos\theta_z = \cos 21.8 = 0.9285$

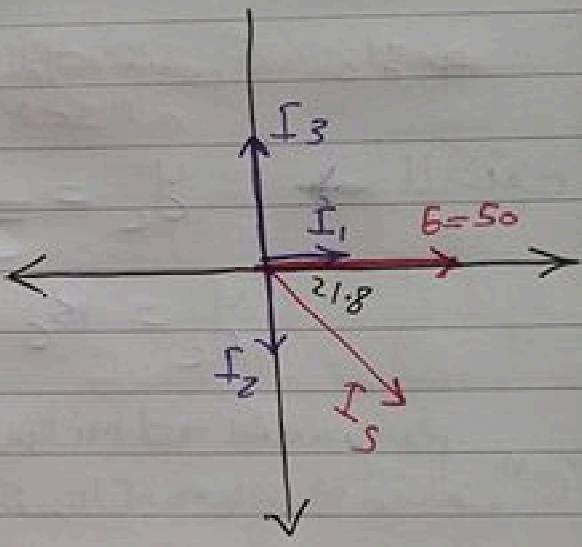
$PF = 0.9285$ "lag".

$\Rightarrow I_s = \frac{E}{Z} = \frac{50\angle 0}{3.714\angle 21.8} = 13.46\angle -21.8$

$\Rightarrow I_1 = \frac{E\angle 0}{4\angle 0} = \frac{50}{4}$

$\Rightarrow I_2 = \frac{50\angle 0}{5\angle 90} = 10\angle -90$

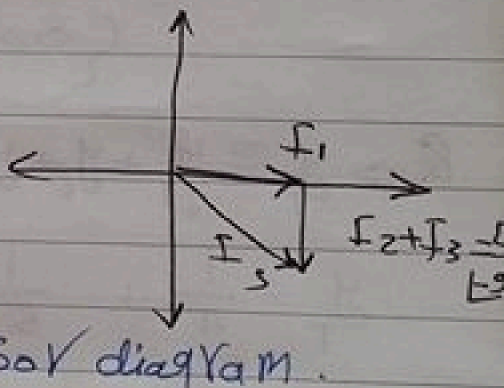
$\Rightarrow I_3 = \frac{50\angle 0}{10\angle -90} = 5\angle 90$



$\Rightarrow P_s = E I_s \cdot P.F$

$\therefore P_s = 50 * 13.4 * .9$
$= 625$

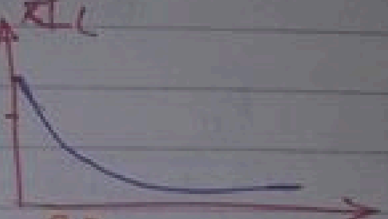
$P_R = \frac{E^2}{R_1} = \frac{(50)^2}{4} = 625$



Phasor diagram.

مخطط التيار

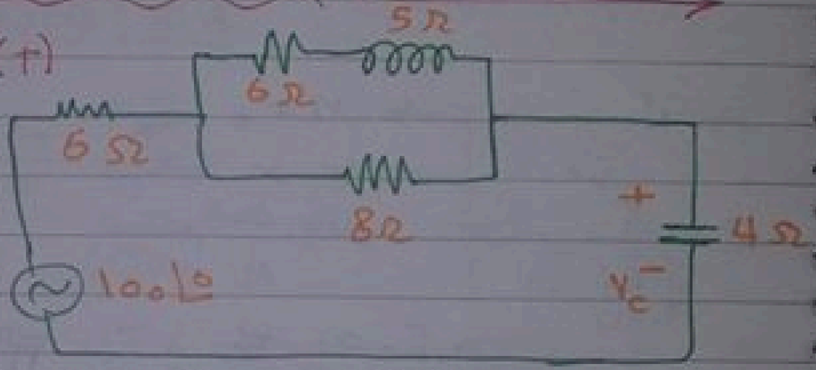
$X_L = I_s \dfrac{R}{R + jX_L} = \dfrac{IR}{\sqrt{R^2 + (X_L)^2}} \angle -\tan^{-1}(X_L/R)$



at $f = 0 \rightarrow I_L = I$

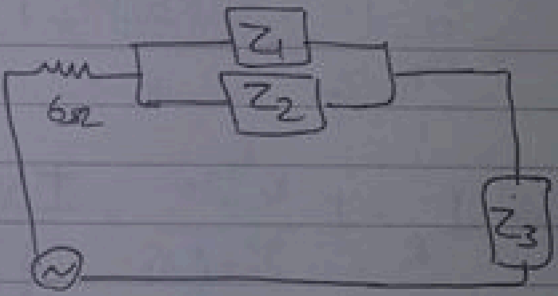
→ Sketch $e, i(t)$

pf = ??



$Z_1 = 6 + 5 \angle 90 = 6 + j5 = 7.81 \angle 39.8$

$Z_2 = 8 \angle 0 \quad , \quad Z_3 = 4 \angle -90$



$Z_4 = Z_1 \parallel Z_2 = \dfrac{Z_1 Z_2}{Z_1 + Z_2}$

$Z_4 = \dfrac{7.8 \angle 39.8 * 8 \angle 0}{6 + 8 + j5}$

$\therefore Z_4 = 4.2 \angle 20.16$

$Z_T = 6 + Z_4 + Z_3$

$\therefore Z_T = 6 + 4.2 \angle 20.16 + 4 \angle -90 = 8.343 \angle -17.8$

$\rightarrow I_T = \dfrac{100 \angle 0}{Z_T} = 12 \angle 17.8$

$pf = \cos(-17.87)$ leading.

$\Rightarrow V_c = I_T Z_c = 12 \angle 17.87 * 4 \angle -90$

$e = 100\sqrt{2} \sin \omega t$

$i = 12\sqrt{2} \sin(\omega t + 17)$

ازاى نحول من ∇ لـ Y

* ازاي نحول المقاومات من الشكل 1 ∇ للمقاومات على شكل Y 2 ؟!

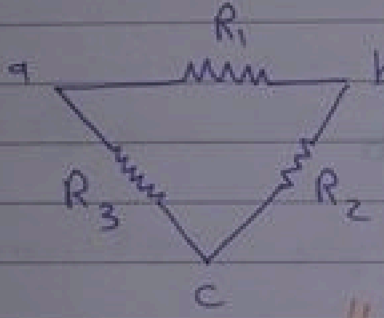


fig 1

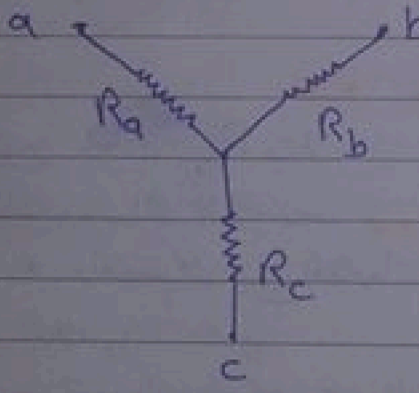
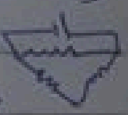
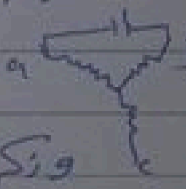


fig 2

* هنبص على الشكلين من نفس الاتجاه ونشوف النقطتين اللي عملنا ونفرض بطارية متوصلة بالنقطتين دول مرة في الـ fig_1 ومرة في fig_2 ونجيب المحصلة للمقاومات ونساويهم مع بعض .. يعني مثلاً هنبص من فوق من fig_1 هيقابلنا المقاومة R_1 والنقطتين ab هنفرض البطارية عليهم



وفي نفس الوقت نبص على fig_2 من فوق ونوصل بطارية بين a,b ونجيب بعدين R_T



ونكرر العملية دي ٣ مرات مرة ع الـ cb ومرة ac

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Solution

Fig 1 | Fig 2

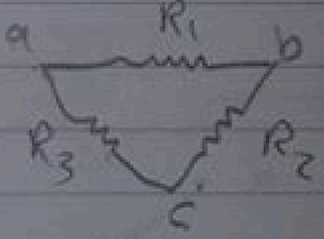
$$\frac{R_1(R_2+R_3)}{R_1+R_2+R_3} = R_a + R_b \rightarrow (1)$$

$$\frac{R_1R_3+R_2R_3}{R_1+R_2+R_3} = R_a + R_c \rightarrow (2)$$

$$\frac{R_1R_2+R_2R_3}{R_1+R_2+R_3} = R_c + R_b \longrightarrow (3)$$

من ١، ٢، ٣ ينتج ٣ معادلات

$$\rightarrow R_a = \frac{R_1 * R_3}{R_1+R_2+R_3} \rightarrow *$$



$$\rightarrow R_b = \frac{R_1 * R_2}{R_1+R_2+R_3} \rightarrow **$$

$$\rightarrow R_c = \frac{R_2 * R_3}{R_1+R_2+R_3} \rightarrow ***$$

وهنا نيجي نجيب R_a مثلاً... نضرب المقاومتين اللي طالعين من النقطة a ونقسم على مجموع المقاومات وكذلك ~~النقطة~~ R_b بنضرب المقاومتين اللي طالعين من النقطة b ونقسم على R_T تولك... وكذلك R_c

Hi. St

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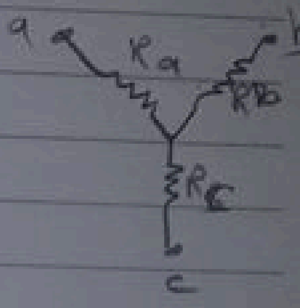
from *5** 5 ***



$\Rightarrow \; R_1 = R_a + R_b + \dfrac{R_a R_b}{R_c}$

$\Rightarrow \; R_2 = R_b + R_c + \dfrac{R_b R_c}{R_a}$

$\Rightarrow \; R_3 = R_a + R_b + \dfrac{R_a \cdot R_b}{R_c}$

is R_T

=10